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HYDROGRAPHIC DEPARTMENT  
OF  
IMPERIAL JAPANESE NAVY

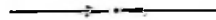
TÔKYÔ  
1926



HYDROGRAPHIC DEPARTMENT

OF

IMPERIAL JAPANESE NAVY



TÔKYÔ

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## PREFACE.

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Since the establishment of this Department, fifty-two years have elapsed. During this long span of years, all of our predecessors devoted their energy to the utmost for the progress and development of its work, with sturdy exertion and constant attention, keeping the Office work abreast with the times, bringing it to its present perfected condition.

Now we deem it our pleasant duty to introduce to all concerned, the fruits of the painful task of our predecessors, on this occasion, when the plan of the compilation of the Charts and Nautical publications, respecting to the Pacific and Indian Oceans, has been completed.

The foregoing statement is the reason why we publish this short history of our Department.

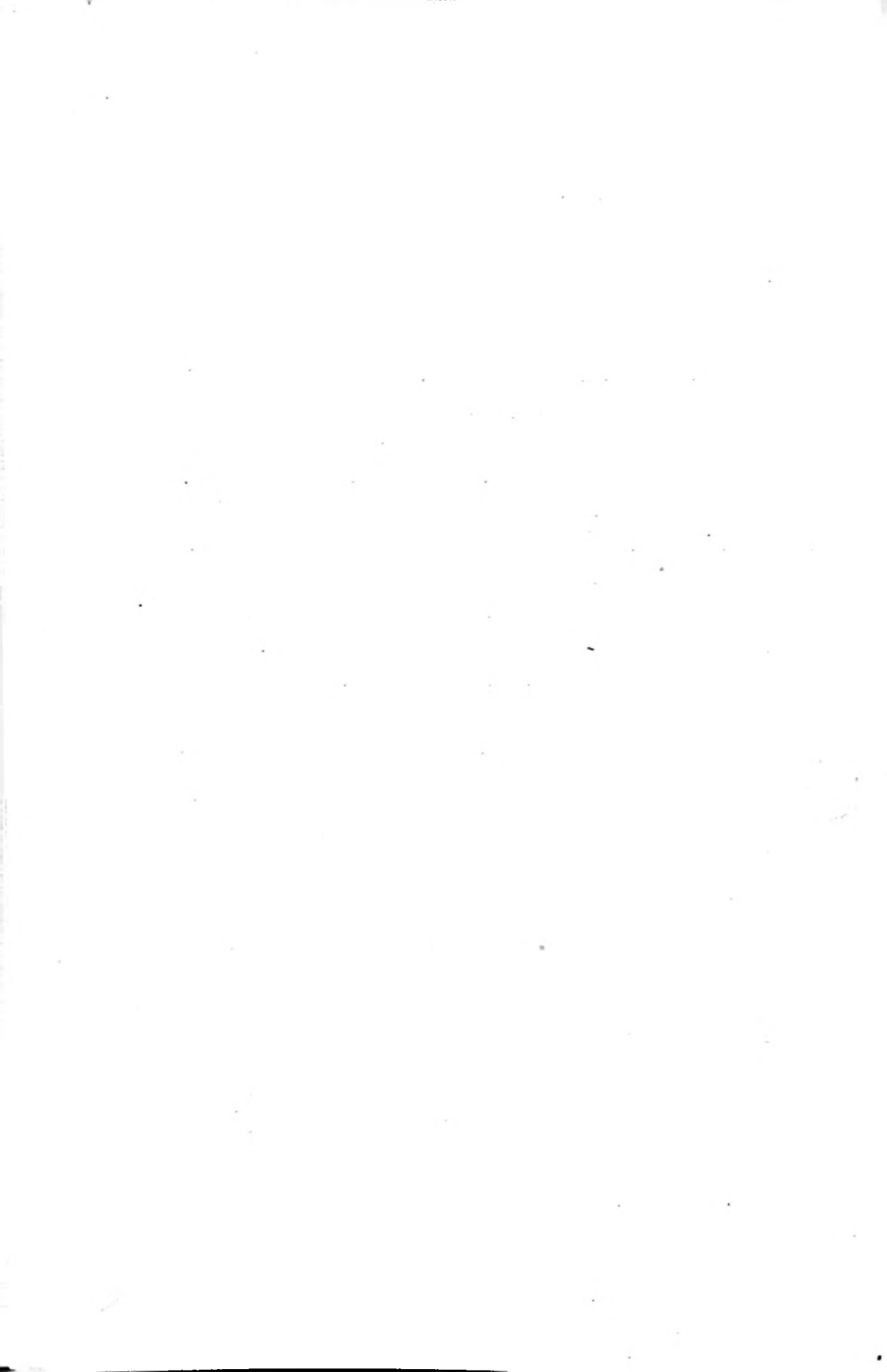
S. Inuzuka,

Rear-Admiral and Hydrographer.

Hydrographic Department,

Tôkyô.

May, 1923.



## PREFACE TO THE REVISED EDITION.

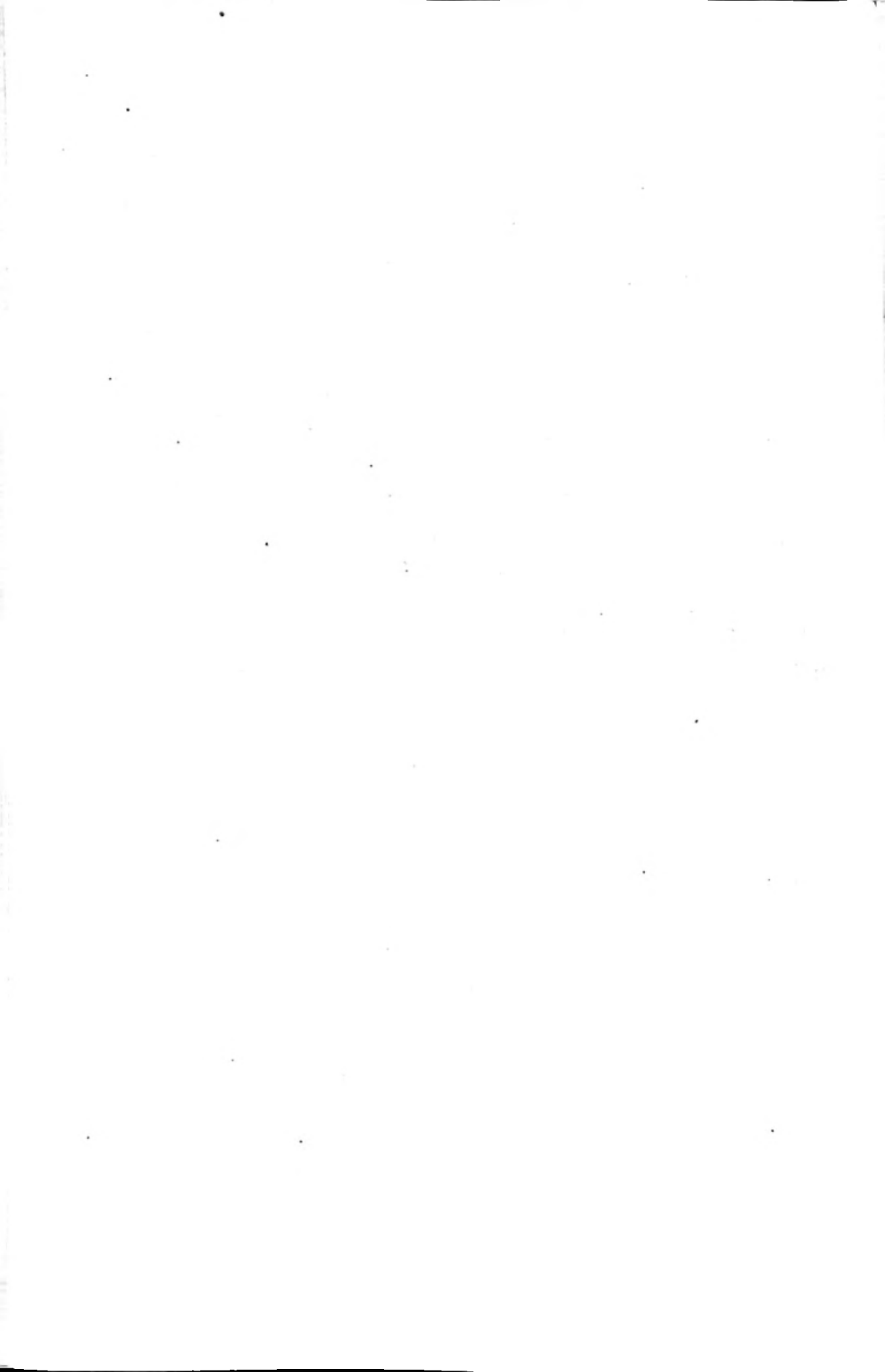
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The great earthquake and fire of September 1st, 1923, unprecedented in the annals of this country in the immensity of the losses caused, completely destroyed the fruits of the long years of earnest and laborious efforts by this Department in the field of hydrography. The staff of the Department, however, soon rose to the occasion, and in spite of the immense difficulties besetting them they have steadfastly striven to regain their former activities, so that their work of restoration is now nearly completed, it only remaining for them to bring the internal equipment of the Department to a pre-earthquake state of replenishment. It appears to us that, in publishing at this junction this revised edition of a short history of this Department, we are filling an apparent need.

S. Yonemura,  
Rear-Admiral,

Director of the Hydrographic Department.

August, 1926, Tôkyô.





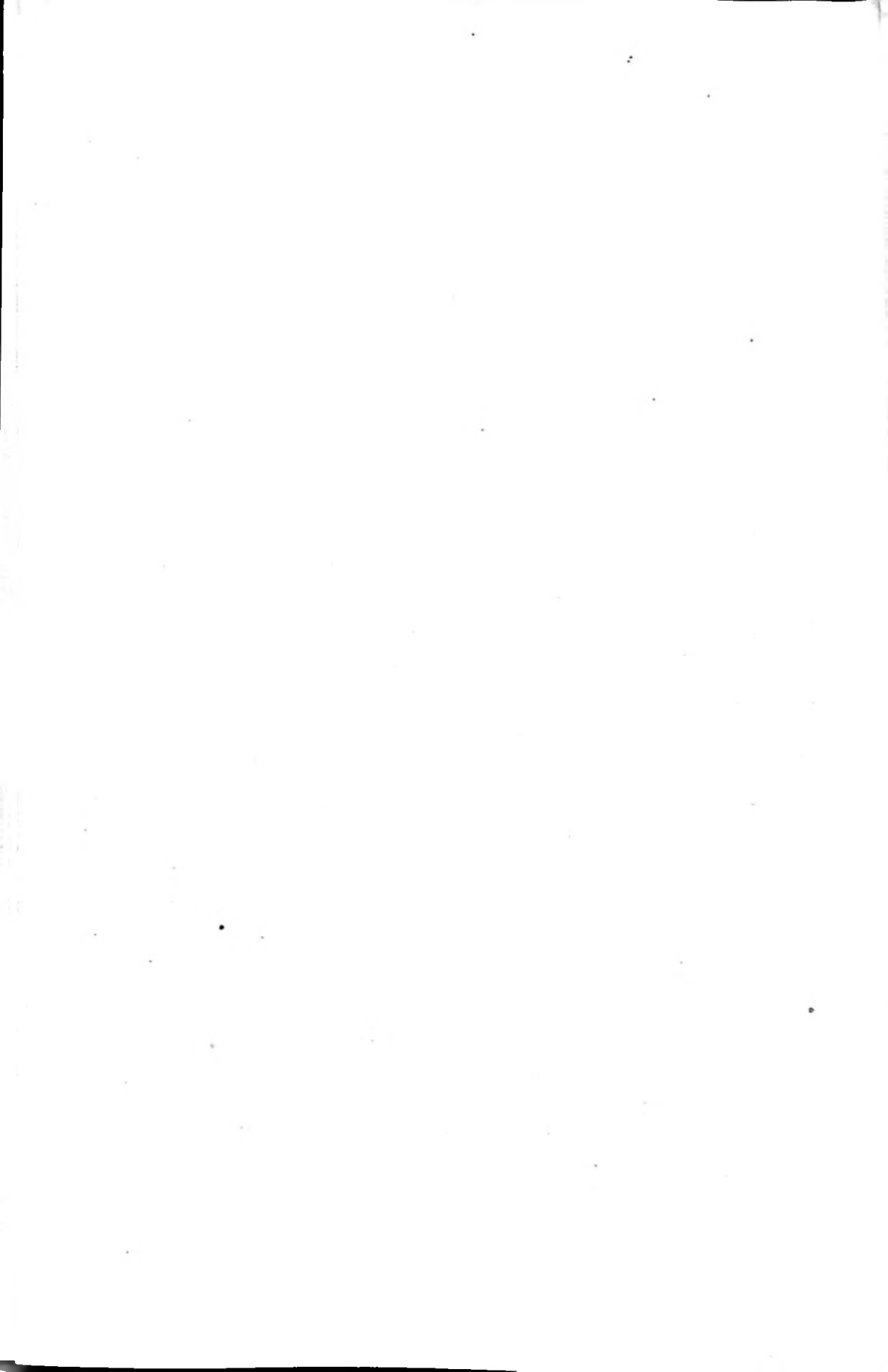
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### Photographs and Charts :

Late Rear-Admiral Narayoshi Yanagi, the First  
(1872-88) Director of the Department.

The chart showing the works carried out and pro-  
jected by this Department to the end of 1925.





Late Rear-Admiral Narayoshi Yanagi, the first (1872–1888)  
Hydrographer of Japan.



# HYDROGRAPHIC DEPARTMENT

## TÔKYÔ

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### HISTORY.

Tradition ascribes the first sketch map of Japan to Gyōki, a Japanese Buddhist priest, and dates it A.D. 740. Of the maps produced subsequently, the first place is assigned that compiled by Tadataka Inō, a samurai who in 1775, in his fiftieth year, began his studies of surveying under Sakuzaemon Takahashi, the then official astronomer in Edo (now Tôkyô). In 1800, Inō, with a small number of assistants, started, under an order of the Tokugawa Shogunate, one of the most remarkable surveys ever conducted in Japan, which continued for 17 years and covered the whole country.

Having no knowledge of the method of triangulation, Inō measured distances mostly by means of an instrument containing vehicles, which registered automatically the distance it travelled, and of distance-measuring lines, being however obliged sometimes to revert to the method of measuring by steps. He also used an azimuth compass to determine the amount of the bend of roads or coast lines and a quadrant to measure their inclinations. To correct

the errors which might exist in the results obtained through these rather rough methods, he would carefully examine the actual bearings between many distant and distinct objects. Every evening, when the sky was clear, he made certain astronomical observations with a large quadrant to determine the latitude of the place he was in. For the purpose of determining longitudes, he made observations of solar and lunar eclipses and obtained reliable figures, but not without great difficulties owing to the rarity of opportunities for making such observations. His maps, however, were admirably accurate, the largest error in latitude, for instance, not having exceeded one minute, and afforded most valuable information for the survey plans of this Department as well as of British surveying ships.

The charts issued for the first time in Japan were those prepared in 1859 by the Naval Training Station, Edo, according to the Dutch system of signs and abbreviations, from original surveys by instructors in the station.

It was in 1869 that Sumiyoshi Kawamura, Chief of the Naval Branch of the War Department, who keenly felt the necessity of executing hydrographic work, appointed Narayoshi Yanagi and Shunkichi Itō to the task. In the following year, N. Yanagi and others in the warship "Daiiti-Teibō-Maru," in co-operation with the British man-of-war "Sylvia," started their first surveying work in the southern districts of this country, namely, Matoya and Owashi anchorages, Shiaku Islands and Bisan Pass. From the next year, these officers conducted surveys by themselves.

N. Yanagi, who became afterwards Director in the

early stages of this Department, from 1872 to 1888, was a man of robust health and unparalleled energy, and, while in its service for a continuous period of twenty years beginning with 1869, made most strenuous efforts to enlarge and improve the Department.

First established in 1871, thanks to the exertions of these people, under the War Department as the Naval Hydrographic Department, this Department, as a result of the establishment in the following year of the Navy Department, was transferred to the latter Department at the same time. The Official Regulations for the Navy enacted then for the first time provided for the Hydrographic Department as follows :

“ The Hydrographic Department shall manage hydrographic survey, make recommendations regarding fairways, take charge of the erection and renovation of, and also appoint personnel for, aids to navigation, etc..”

In 1876, the foregoing provisions were revised to read :

“ No. 1. The Hydrographic Department shall direct the survey of seas and rivers, issue charts and sailing directions, and shall take charge of surveying instruments.

“ No. 2. The Hydrographic Department shall be divided into four sections, which shall take charge of general affairs.

In 1874 was established the Naval Observatory, charged with astronomical, meteorological and magnetic observations and placed under the control of this Department.

In 1882, the Hydrographic Department secured the

approval of the Naval authorities to an important proposal of its own, in which it was projected to survey the whole coast of Japan in twelve years by employing overland surveying parties, who should, of course, embark on boats when necessary. This proposal was made in view of the fact that circumstances then held forth no promise of a ship exclusively for surveying service being built in the immediate future, while the surveying ships temporarily commissioned as such often stood in need of repairs or of some special equipments, which were liable to prevent the surveying parties' departure at the proper time.

In 1886, the Official Regulations were revised to the effect that this Department shall comprise one Observatory and four Divisions for Survey, Charts and Books, Surveying Instruments, and Accounts. Two years later, the Regulations were again revised, in consequence of which meteorological and magnetic observations came to be directed by the Home Department instead of by the Navy Department, and astronomical observations by the Educational Department.

In 1897, this Department found itself in a position to supply ships with charts fairly satisfactory in respect of their contents as well as their variety, which enabled the ships to coast about in safety in almost any part of this country.

In 1913, in consequence of the Naval Arsenal having been authorized to take charge of surveying instruments, the Surveying Instrument Division of this Department was abolished.



In the fiscal year 1917-18, the survey of the whole coast of this country was finished; since then the Department has carried on some re-surveys, new surveys of South Sea Islands (Mariana, Marshall and Caroline) under our mandatory rule. Investigations of oceanic currents and observations of such oceanographical elements as the depth of the sea, characters of sea bottom, temperature and specific gravity of sea water, were made at the same time.

In the fiscal year 1919-20, the Almanac Compiling Division was started; and in October, 1920, the Hydrographic Department Regulations now in force were promulgated.

On the 1st September, 1923, there occurred a great earthquake apparently in the ocean bed of Sagami-Nada and caused tremendous losses of life and property over a wide area comprising Tôkyô, Yokohama and vicinities. Remarkable changes were observed both on land and in sea bed through a preliminary survey of Sagami-Nada, Tôkyô-Kaiwan and vicinities, and extended surveys were consequently undertaken by this Department for the purpose of obtaining exact data of these changes in the interest of practical navigation and scientific inquiry.

The survey was begun at the end of September. Four surveying ships executed the soundings in the deep waters off the coasts, while four surveying parties surveyed the coasts and the shallow waters. The work was completed at the middle of January, 1924, the area covered being about 2500 square nautical miles.

At the same time, strenuous efforts were made to res-

tore the activities of this Department, which had lost its entire records, plates, and materials, through the great fire following the earthquake.

At present we are conducting our business in temporary barracks built at the old site of this Department at Tukizi, Tôkyô, and all our activities are being gradually restored to their former conditions. The new permanent buildings are expected to be completed within a few years.

We desire to take this opportunity of expressing our hearty thanks to the Hydrographic Services of other countries, and to the International Hydrographic Bureau, for their timely and much needed assistance rendered us immediately after the great catastrophe.

This Department commenced the various branches of its work in the years undermentioned :

Kind of work.	Year	Remarks.
Survey (unaided).	1871	Notuke Anchorage, Goyomai Pass, Suttu Bay, and Otaru Harbour surveyed by Lieut. Yanagi, commander of the Kasuga.
Hydrographic descriptions.	1872	An account of his "Hokkai Survey" voyage by the Kasuga written by Lieut. Yanagi.
Tidal observations.	1872	Forty days' observation made in Sinagawa Bay.
Magnetic observations.	1872	Magnetic declination observed at the temporary site of the Hydrographic Department.
Chart engraving.	1872	The chart of Kamaisi Anchorage engraved on copper plate.

Issue of charts.	1872	The charts of Miyako Anchorage, Suttu Anchorage, and Otaru Harbour issued.
Sailing Directions.	1873	The Hokkaidô Pilot issued.
Notice to Mariners.	1873	A shoal "Kamize" near Ôsima Anchorage noticed.
Astronomical and Meteorological observations.	1874	The Naval Observatory organized.
Storm-warnings.	1881	From 1890 onward these warnings have been issued by the Central Meteorological Observatory, instead of by this Dept.
Light Lists.	1883	Including Japan, China, Tyôsen, Asiatic Russia and approaches.
The Naval Observatory	1888	Abolished.
Nautical Almanacs.	1900	Two Volumes, including a Tide Table.
Tide Tables.	1921	Published separately from Nautical Almanac.
Hydrographic Bulletins.	1922	"Suiro-Yôhō" issued monthly.
Wireless Information.	1926	Urgent notices to mariners.

The names, official ranks, and periods of service of the successive Directors follow :

Name.	Period of service.	Official rank when entering and leaving the service.
Narayoshi Yanagi.	1872,—April, 1888.	Commander. Rear-Admiral.
Kanetsura Kimotsuki.	April, 1888,—December, 1892.	Captain.
Michiaki Yoko-o.	December, 1892,—June, 1894.	Captain.
Kanetsura Kimotsuki.	June, 1894,—November, 1905.	Captain. Vice-Admiral.
Kazu Matsumoto.	November, 1905,—November, 1906.	Rear-Admiral.
Hazime Sakamoto.	November, 1906,—August, 1908.	Captain. Rear-Admiral.
Odorū Nakao.	August, 1908,—December, 1911.	Rear-Admiral. Vice-Admiral.
Otojiro Itō.	December, 1911,—April, 1912.	Rear-Admiral.
Reijirō Kawashima.	April, 1912,—December, 1913.	Rear-Admiral. Vice-Admiral.
Rinroku Yeguchi.	December, 1913,—December, 1914.	Rear-Admiral.
Yukitoshi Kamimura.	December, 1914,—December, 1915.	Rear-Admiral.
Rokurō Kamaya.	December, 1915,—December, 1916.	Rear-Admiral.
Mitsuzō Nunome.	December, 1916,—October, 1920.	Rear-Admiral.
Sukejirō Inuzuka.	October, 1920,—June, 1923.	Captain. Rear-Admiral.
Kosaburō Uchida.	June, 1923,—December, 1924.	Rear-Admiral.
Nobuo Uyemura.	December, 1924,—December, 1925.	Rear-Admiral.
Sueki Yonemura (Present Director).	December, 1925.	Rear-Admiral.

## ORGANIZATION.

The Hydrographic Department conducts the preparation and issue of hydrographic publications, undertakes the survey of coasts and seas, makes recommendations, and issues notices regarding safety of navigation with a view to rendering navigation easier and safer, and educates hydrographic officers and their assistants.

The Director is placed under the Minister of the Navy, and directs the work of the Department.

The Adjutant manages general affairs.

The Department is divided into five Divisions, namely, the First, the Second, the Third, the Fourth, and the Accounts.

The First Division conducts business connected with the following :

1. Planning the compilation of charts and books and planning surveys.
2. Compilation of sailing directions, light lists and other hydrographic as well as miscellaneous publications.
3. Notices to mariners.
4. Investigation of terrestrial magnetism, oceanography and oceanic meteorology.
5. Information about fairways and harbours and study of routes.
6. Scientific researches in hydrography.

The Second Division conducts business connected with the following:

1. Actual conduct of surveys.
2. Preparation of original charts and hydrographic accounts.
3. Technical education of the hydrographic officers and subordinate assistants engaged in surveying work.

The Third Division conducts business connected with the following:

1. Compilation of charts.
2. Drawing of charts, photography, preparation of plates, and printing.
3. Technical education of the personnel engaged in the foregoing works.
4. Provision, supply, exchange, distribution or contribution, lending and custody of hydrographic publications.
5. Correction and supplementing of hydrographic publications in the custody of the Division.
6. Sale of hydrographic publications.

The Fourth Division conducts business connected with the following:

1. Calculation of the places of the heavenly bodies from the Tables of those bodies.
2. Investigation of tides.
3. Compilation of nautical almanacs, tide tables, and nautical tables (for astronomical navigation).

The Accounts Division conducts business connected

with the following:

1. Revenue and expenditure.
  2. Purchase and sale of office supplies.
  3. Receipt, custody and delivery of office supplies.
  4. Correspondence and transportation.
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## SURVEYS.

T. Inō's geodetic survey of the whole Japanese inshore region, extending over seventeen years and ended in 1816, was briefly referred to in the chapter on History. The first hydrographic survey in Japan was, it may be authoritatively stated, carried out by I. Matsuoka, Instructor of the Naval Training Station in Edo, the results being charted and published by the School in 1859. A few districts were surveyed later, and several charts were published in 1865, among which may be mentioned a large chart of Owari Bay prepared from surveys by K. Fukuoka, First Class Officer of the Navy.

As a matter of fact, no systematical hydrographic survey of the country was undertaken by Japanese before N. Yanagi and S. Itō were, in 1869, appointed naval officers and entrusted with hydrographic work by S. Kawamura, Chief of the Naval Branch of the War Department of the time. A certain number of harbours and bays of Japan were surveyed by foreign ships during a period of over ten years from the last days of the Tokugawa Shogunate to 1882, when the offer of assistance by foreign ships was declined by our authorities because of the establishment of a grand surveying plan by this Department.

In 1870, Yanagi and others embarking on the warship "Daiiti-Teibō-Maru" carried out in co-operation with the British surveying-ship "Sylvia" their first surveying work



in the southern districts of this country, namely, Matoya and Owasi Anchorages, Siaku Islands, and Bisan Pass. In this enterprise, our surveyors who had no previous experience of hydrographic work, especially of soundings, suffered considerably from the antiquated condition of their instruments, for which reason the Captain of the British ship kindly allowed them to make use of the spare instruments on board her. The survey, however, was attended by a fair measure of success, and supplied information useful to the succeeding surveys.

In 1871, the "Kasuga", Commander Lieutenant Yanagi, was despatched on surveying service to Hokusyû, the northern Japan. She was accompanied by the "Sylvia", but this time the two ships, after mutual consultation, surveyed different districts; Notuke Anchorage, Goyômai Pass, Suttu Bay, and Otaru Harbour being surveyed by the "Kasuga", and several other districts by the "Sylvia". The "Kasuga" also surveyed Miyako kô and Kamaisi kô on her homeward voyage. These surveys mark the commencement of the our surveying work independent of foreign assistance.

In the few years succeeding, the work was carried on by two or three warships. As, however, these ships were only temporarily placed at the disposal of the Director in compliance with his most earnest request, our surveying parties were liable to miss the most favourable season for their enterprises. From 1878 onwards, this Department despatched every year to various districts parties of overland surveyors, who of course made use of small boats when necessary, the first of such surveys having been carried out on

the coast of Higo, Kyûsyû.

The Department, in its early days, devoted its attention to ports or bays, no general coast survey having been undertaken until 1881, when the warship "Raiden" surveyed three hundred miles, or a direct length of seventy miles, of the north-eastern coast of Honsyû.

Towards the end of 1881, by the order of Director N. Yanagi, Lieutenant Kimotsuki, Chief of the Survey Division, drafted a plan for the survey of the whole Japanese coast, excluding the detached islands, by overland surveying parties, to be completed in twelve years. This plan was accepted by the Naval authorities in the following year, and the survey was energetically executed both by the surveying-ships and the overland parties.

The length of the coast line, which had been surveyed by the time this plan was contemplated, was as follows :

Total coast line of Japan ... ..	15,183 miles
Coast line surveyed ... ..	5,064 "
by this Department ... ..	1,448 "
by foreign ships ... ..	3,616 "
Coast line roughly surveyed ... ..	664 "
by this Department ... ..	121 "
by foreign ships ... ..	543 "
Coast line unsurveyed ... ..	9,455 "

Although the above-mentioned plan was steadily proceeded with from 1882, the time spent in the resurvey of all coasts previously surveyed by foreign ships and portions of the coasts surveyed by Japanese ships combined with the increase of our coast line through the Sino-Japanese and

Russo-Japanese wars to delay the achievement of the plan until 1917.

When the "Daiiti-Teibô-Marû" set out on her mission in 1870, her work was carried out by her seven officers, there being no specialists attached to her then. But, afterwards the deck officers educated in surveying, hydrographic experts, and their assistants gradually increased; so that there were employed, from 1882 to 1885, in this line of work twelve men generally forming two surveying parties, and from 1886 onwards three such parties could be despatched at the same time.

A severest blow was dealt this Department by the destruction of the valuable surveying data obtained previous to that date by the great earthquake of September 1st, 1923, which reduced the Department to the necessity of resurveying a part of those areas which were surveyed within recent years. The districts affected by the earthquake were resurveyed immediately after the disaster, as stated in the chapter on History. At present, the Department has forty-five men engaged in its surveying service, from whom six or seven surveying parties can be formed, and over forty small surveying boats, most of which are equipped with oil motors, four or five warships being specially commissioned every year for the same service.

Year	Land area surveyed (square mile)	Sea area surveyed (square mile)	Coast line (mile)	Number of soundings
1917	543.0	7,836.8	849.3	118,566
1918	2,426.2	3,320.8	1,751.3	108,403
1919	5,172.0	22,408.3	1,638.1	56,534

1920	4,031.5	26,676.4	1,741.7	110,136
1921	2,847.9	41,313.4	1,235.3	100,964
1922	3,980.6	24,842.6	1,071.4	68,160
1923	2,679.4	14,802.2	1,204.3	152,458
1924	296.1	613.8	332.0	44,004
1925	602.3	8,279.2	599.2	77,837

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## DETERMINATION OF LATITUDE AND LONGITUDE.

Since the commencement of our work in 1871, whenever a survey has been carried out, the determination of the latitude and longitude of the district surveyed has always formed part of its necessary functions. The following table shows only the number of stations where the latitude or longitude was observed in or after 1876, with the results appearing on our charts.

"a" means both latitude and longitude determined. Remarks: "b" means longitude only determined. "c" means latitude only determined.										
District Period	Kind	Honsyû, Southern Islands.	Kyû- syû.	Siko- ku.	Hokkai- dô.	Kara- huto.	Tyôsen, Kwan- tung Province	Tai- wan.	South Sea Is- lands.	Total.
1876	a	8	4	3	1					16
	b	2			1					3
to	c	3	1							4
1887	total	13	5	3	2					23
1888	a	11	2	1	3					17
	b	2	2		2					6
to	c	22	4	2	6		1			35
1897	total	35	8	3	11		1			58
1898	a	7	5		3		1	1		17
to	b									
	c	1	1		6	1	5	1		15
1907	total	8	6		9	1	6	2		32
1908	a	9	4		3	1	1		4	22
to	b	2								2
	c	5	1			3	2			11
1920	total	16	5		3	4	3		4	35

1921 to 1925	a b c total								6	
									6	
Grand total	a b c total	35 6 31 72	15 2 7 24	4 2 2 6	10 3 12 25	1 3 4 5	2 3 8 10	1 1 1 2	10 11 65 154	78 11 65 154

Our secondary standard of longitude, which was adopted for the first time in March, 1872, was the longitude of the British Naval Hospital at Yokohama,  $139^{\circ}-39'-24''$  East of Greenwich. The following month, it was transferred to the longitude of a staff standing in the grounds of the Navy Department in Tōkyō, which is  $139^{\circ}-45'-25''.05$  east.

In August of the same year, K. Ōtomo, a naval officer, determined the latitude, longitude, and magnetic declination of the temporary site of the Hydrographic Department as follows, which became the base for navigational purposes for naval ships :

Latitude..... $35^{\circ}-39'-24''.46$ .

Longitude..... $139^{\circ}-45'-37''.4$ .

Magnetic declination..... $3^{\circ}-58'-20''$ west:ly.

In July, 1874, the Naval Observatory was constructed. The subsequent increase and development of the equipment of the observatory facilitated its meteorological and magnetic observations; and the results were published by this Department periodically.

In September, 1874, several foreign astronomers came over to this country to observe the Venus's transit over the sun's disk, and erected their own observation stations, American at Nagasaki, French at Nagasaki and Kōbe, and

Mexican at Yokohama. First Class Sub-Lieutenant Ôtomo and several other members of this Department were despatched to these stations to study the advanced methods of observation as followed by these foreign astronomers and also to take their own observations.

In 1874-75, Captain Yanagi and Prof. George Davidson and two other American astronomers observed by telegraphic method the difference of longitude between Tôkyô and Nagasaki from which, supplemented with foreign data, the base for the determination of all longitudes of Japan was established.

In November, 1876, the latitude of the Observatory was determined.

In September, 1885, having received information as to the results of U. S. naval officers' telegraphic determination of longitudes between Madras and Nagasaki, the Naval Observatory declared that the longitude of the Observatory should be  $139^{\circ}-44'-30''.3$  east. This value was adopted as the base of all longitudes of this country during the next thirty-four years.

In June, 1888, the Observatory was transferred to and came under the charge of the Educational Department and was newly named "the Tôkyô Astronomical Observatory."

In 1915-16, this Department determined the longitude of the Tôkyô Astronomical Observatory to be  $139^{\circ}-44'-40''.9$  E. of Greenwich by the weighted means of two independent values of its longitude, which differed by  $1''.4$ , and which were obtained by our observations taken in the opposite directions from Greenwich, one through Guam and the other through Vladivostok. This value of longitude has, since

September, 1918, been adopted as the longitude upon which all longitudes in Japan should thereafter depend.

In 1919, this Department began to use, instead of a transit instrument, a small theodolite provided with an accurate Talcott's level, to observe the time and latitude by the method of equal altitudes of two different stars. The longitude and latitude resulting therefrom are comparatively accurate. The special merit of this method lies in the fact that we were thereby enabled to dispense with the use of a heavy transit, to transport and set which had cost so much to all astronomical expeditions.

For the time determination by equal altitudes of two different stars, this Department has published "Table of Data Required in Observing 200 Selected Star Pairs for Every Complete Degree of North Latitudes  $20^{\circ}$ - $40^{\circ}$  and for the Epoch 1930.0" (The Bulletin of the Hyd. Dep., Vol. III, Tôkyô, 1922), and "Determination of Time by Method of Equal Altitudes of Different Stars, and a Preparative Table for the North Latitudes  $40^{\circ}$ - $60^{\circ}$  and for the Epoch 1930.0" (The Bulletin of the Hyd. Dep., Vol. IV, Tôkyô, 1923).

Lastly, in 1925, we printed in Japanese, for the use of surveyors, an auxiliary table for determining latitude by means of equal altitudes of two different stars, with an explanation of the method attached.

The charts prepared from the surveys executed by the Japanese Navy previous to 1922 made use of astronomical longitudes and latitudes and the measurement calculated from these by referring to Clark's spheroid 1866.



In the charts prepared from the surveys executed in 1922 and henceforward, however, geodetic longitudes and latitudes (those deduced by triangulation from the position of the Tôkyô Observatory, Lat.  $35^{\circ} 39' 17''.5$  N., Long.  $139^{\circ} 44' 40''.9$  E. and by referring to Bessel's spheroid) are used and the longitudes and latitudes of the charts based on the metric system are altered to geodetic measurements, regardless of the year of observation, so that these charts are at a slight variance from the older ones.

## MAGNETIC OBSERVATION.

The first magnetic observation made by this Department was the observation of magnetic declination at the temporary situation of the Hydrographic Office in August, 1872.

From 1882 to 1888, the daily observation of magnetic declination and the half-monthly observation of magnetic inclination and horizontal intensity were carried on by the Observatory. After the Observatory was detached from the Navy, and its magnetic work was transferred to the charge of the Home Department in 1888, this Department executed only the field observation of magnetic declination when despatching hydrographic surveying parties.

In 1912-13, this Department carried out its first complete magnetic survey of Japan at 331 stations uniformly distributed over the country, i. e., at Karahuto (Sakhalin Island), Hokkaidô, Honsyû, Sikoku, Kyûsyû, Tyôsen, Ryûkyû Islands, Taiwan, and Ogasawara Islands, and published the results in "The Bulletin of the Hydrographic Office, Vol. 11, Tôkyô, 1918".

An important part of the results, to which two previous complete magnetic surveys of this country, one in 1887 and the other in 1895, contributed, is that not only the annual accelerations of magnetic elements at many places were worked out, but also empirical expressions were established by which the secular variations of magnetic ele-

ments for the epoch 1904 can be computed.

It was decided then that the magnetic survey of Japan should be repeated decennially by this Department for a complete study of the distribution of terrestrial magnetism in the seas near Japan.

In 1922-23, this Department carried out its second decennial magnetic survey over the large area extending to the Chinese coast and to the South Sea Islands under the Japanese mandate, with the main islands of Japan for the centre. The total number of stations was reduced to 148 and the survey, commenced in June, 1922, was finished in August, 1923.

It is to be greatly regretted that all original records of this survey were destroyed by the great earthquake and fire of September, 1923. But fortunately the rough sketches of the mean value of a series of observations at each station were saved from the calamity and have supplied the indispensable data for computation of the distributions of terrestrial magnetism for the epoch 1923.

The Chinese Government, who accepted our invitation to co-operate with us in the survey of the Chinese coast, made observations of the three magnetic elements at 18 stations scattered along the coast and supplied us with the data thus obtained.

This Department computed the distributions of terrestrial magnetism in the seas of the Far East from the above data, by duly referring to the results of land and ocean magnetic observations by the Carnegie Institution of Washington and by the local magnetic observatories.

Thus the magnetic charts in the seas near Japan for the epoch 1923 were published in 1925-26. The Volume V of the Bulletin of this Department which contains the details of the second decennial magnetic survey and distributions of terrestrial magnetism in the Far Eastern region, has just been printed.

The Department is utilizing every opportunity presenting itself to take occasional magnetic observations, when it sends out hydrographic surveying parties to any quarters. This kind of magnetic observation has recently been extended to most parts of the Mariana, Caroline, and Marshall Islands, where no thorough magnetic survey has yet been secured.

On the other hand, in order to study more exhaustively the magnetic elements at different quarters of the country the Hydrographic Department has entrusted a number of the meteorological stations as shown in the following list with the absolute measurement of the magnetic elements.

Meteorological Station	Locality	Element Measured	Year of Commencement
Zinsen	Tyōsen	Decl., Dip, Hor. Intensity	1918
Ôtomari	Karahuto	Declination	1920
Taihoku	Taiwan	Declination	1919
Palau	Caroline	Declination	1926

The measurements are to be made 4 times at fixed mean times on a fixed day of each week. The number of such stations will be increased when circumstances permit.

## TIDAL WORKS.

### Tidal Observation and Harmonic Analysis.

Since about 1883, in connection with coastal survey, our surveying parties have made at many stations from half a month to several months' tidal observation: and from the data thus obtained, the harmonic constants of six component tides, namely,  $M_2$ ,  $K_2$ ,  $K_1$ ,  $O$ , and  $P$  for each station have been calculated by the method of Sir George H. Darwin. The stations, of which these components have been determined, number at present as many as 500.

Since 1909, to obtain more accurate data of tides, self-recording tide gauges have been equipped at 17 stations, and these have recorded more than one year's tide curves, the periods of observation being about 30 years in total. From the data thus obtained as well as information from several other harbour authorities, twenty-eight components for about 40 stations have been, or are being calculated, the total periods of observation reaching about 60 years.

### Observation of Tidal Currents.

Although our surveying parties have observed tidal currents as much as possible, the data hitherto obtained are still of a very limited description. In these few years, therefore, this Department has specially despatched several tidal current surveying parties to make several months' surveys at certain districts, well-known for their swift tidal currents and of navigational importance. Thus, we have fairly in-

vestigated tidal currents at 10 districts, 9 of which are in the Inland Sea, have published currents charts for 7 of them, and predicted currents by harmonic constants for 3 channels.

#### Important Publications.

**Tide Tables:** Since 1921, these tables have been published in book form, instead of in the Nautical Almanacs as formerly. "The Tide Tables for the year 1926" contains:

The tables of the predicted times and heights of high and low waters for twenty-six principal ports in Japan, Russian Tartary, China, Eastern Archipelago, and approaches. Of these tables those for nineteen harbours were obtained by a Kelvin's tide-predictor fitted with 15 components, and for six others from the British Hydrographic Department, and for the remaining one from the German "Seewarte".

Tidal constants and differences by means of which the tides at more than 1,200 intermediate ports may be obtained.

The tables of predicted times of turns of tidal currents and their maximum velocities for three channels in the Inland Sea.

**Current Charts:** Current charts have been issued for seven places in the Inland Sea.

"The Account of the Tides and Tidal Currents at Naruto", compiled by G. Daigo in 1903.

"Tides and Currents in Japan and the adjacent waters" compiled by S. Ogura in 1914, and containing all tidal constants of Japanese coast.

"Suiro Zasso" (Miscellaneous Reports on Hydrography)

Nos. 8,9 & 10: The principal subjects of discussion are the currents in Simonoseki Kaikyô, Kudako Suidô, Akashi Seto, Naruto, Kurusima Kaikyô, Sea of Okhotsk and Gulf of Tartary.

## OCEANOGRAPHICAL AND METEOROLOGICAL WORKS.

This Department began meteorological and astronomical works soon after the Naval Observatory was established and placed under its control in 1874, and published several charts and books referring to meteorology and astronomy from the data obtained by the Observatory as well as by ships. After the Observatory was detached from the Navy, and its meteorological work was transferred to the charge of the Home Department in 1888, this Department, acquiring data from the Central Meteorological Observatory, continued to publish meteorological publications, for instance, the "Monthly Pilot Charts of Japan", appearing from 1904 to 1906, and "Meteorological Tables of the Coast of Japan" issued in 1907.

The personnel of the Survey Division was increased in 1909 in order to study the marine meteorological reports forwarded from ships since 1901, and the Division having obtained general information regarding ocean meteorology, currents, tides, drifting ice, and the temperature and density of sea water, revised the "Monthly Pilot Charts of Japan."

In the same year, for the purpose of current researches, the repairship "Kantô-Marû" dropped a number of current bottles on her way from Tôkyô Kaiwan to Taiwan Kaikyô (Formosa Strait).



Since then many ships have done similar work in various parts of the neighbouring waters.

In 1913, it was officially decreed that the investigation of marine meteorology should form part of the regular functions of this Department.

The studies started from 1916 about meteorological and current data for the North Pacific and the Indian Ocean enabled this Department to compile and issue by 1919 meteorological and current charts of these Oceans.

As to oceanographical survey, the warships "Katsuragi" and "Matsue" made some current surveys in 1911 and 1912. Since 1919 ships engaged in coastal survey, taking advantage of every available opportunity during their voyages to and from the districts to be surveyed, have been making oceanographical researches such as deep sea soundings or the observation of the temperature and density of sea water. But, it is to be desired, for the development of this work, to use ships built exclusively for surveying purposes and also enlarge the present limits of investigation. Since 1925, deep sea soundings and observations of the temperature and salinity of sea water, and investigations of other physical and chemical properties of sea water, in the southern sea of Japan (the western part of the North Pacific Ocean), have been executed by the warship "Mansyû," which still continues to be employed on the same service.

## WORK OF COMPILING ALMANACS.

Because the establishment in 1874 of the Naval Observatory under this Department had for one of its principal objects the compilation of almanacs, the Observatory planned towards 1886 to compile a summary nautical almanac; which attempt, however, owing to certain reasons, could not be brought into execution.

In consequence of the alteration of the Official Organization of the Government in 1888, the Naval Observatory was transferred to the charge of the Educational Department under the new name "The Tôkyô Astronomical Observatory." This Observatory alone under the new organization being authorized to compile almanacs, our Department had no opportunity of carrying out the same work for a quite long time, and was, as previously, obliged to procure foreign nautical almanacs to meet the demand of the Navy. On the other hand, the circumstances which thereafter befell the Tôkyô Astronomical Observatory did not allow of its beginning any such work.

This state of things being considered too serious to be endured for any length of time by a maritime country like Japan, a Committee was formed in 1906 for the purpose of investigating how our nautical almanacs might be compiled. The Director of this Department at the time was appointed the Chairman of the Committee.

Most of the projects recommenced by the Committee

were such as could not be carried into speedy execution on account of financial difficulties. Nevertheless, it was decided that starting from 1907 a concise nautical almanac should be compiled by the Chart and Book Division of this Department.

In order to acquire complete information about similar works in the Occidental countries, many naval officers resident abroad were charged with occasional studies, and in 1909 K. Ashino, then Professor of the Higher Naval College, was specially despatched to Europe and America there to execute his investigations in the course of a year.

In December, 1909, the Almanac Compiling Section was established under the Chart and Book Division, and it commenced the publication of our Nautical Almanac in its present form. In 1919, the Almanac Compiling Division was newly established in place of the said Section, and the Division was renamed "The Fourth Division" in 1920.

In October, 1920, S. Ogura, Naval Engineer in this Division, devised and compiled the "New Altitude and Azimuth Tables", a very simple and useful table for the determination of the position line at sea.

The great earthquake and fire of September 1st, 1923, reduced to ashes almost all the tables and papers for the computation of the places of heavenly bodies which we had collected during many long years. Most of them, however, were soon replaced by purchases and kind contributions from foreign sources.

We take this opportunity of expressing our heartiest thanks to those foreign institutions which made dona-

tions of books, etc., to this Division, but especially to the authorities of the Naval Observatory of Washington, D. C., U. S. A., who in our urgent need supplied us gratuitously with sufficient copies of several volumes of the "Astronomical Papers of the American Ephemeris" containing the tables of the sun, planets and fixed stars.

At present, the places of the sun, certain fixed stars, the four brightest planets and the moon are being computed by this Division.

## CHART MAKING WORKS.

The first charts of Japan were compiled according to the Dutch system of signs and abbreviations from the survey charts prepared by Instructors of the Naval Training Station in Edo and issued by the Station in 1859, but, needless to say, these charts can in no respect bear comparison with those prepared by this Department. The Department, which commenced coastal survey in 1871, issued its first charts in the following year. With the subsequent progress of our surveying work, the Japanese coast charts increased from year to year, while several charts for China and Russian Tartary were compiled mainly from foreign data, so that by 1897 the Hydrographic Department, charts numbered 288 and enabled mariners to navigate the neighbouring waters of Japan in safety.

Thanks to increased expenditure granted the Department and to the constant improvement in the technical education of members, the chart-making work rapidly progressed so that the total number of charts published up to April 1st., 1926, reached 1,486 sheets, covering the entire areas of the North and the South Pacific Ocean and the Indian Ocean. It is intended to issue in the near future charts for the whole world, at least those necessary for passage along the main routes of our merchant ships and the charts of principal commercial harbours.

This Department had been using practically the same

signs and abbreviations as those of the British charts; the size of a sheet had recently been standardized at  $38 \times 25$  inches; soundings had been charted in fathoms or feet, and height in feet; till in October 1920, in consequence of the alteration of the Law of Weights and Measures, the Department adopted the Metric System and decided to revise gradually on the basis of that system all its charts previously issued. The Department published fifty-seven charts on the Metric System before April 1st., 1926.

Charts based on the surveys by the Japanese Navy are generally prepared in the form of plans for all scales larger than  $1/50,000$ , and for smaller scales Mercator's projection is used.

As far as possible, charts of the same scale are used for those covering contiguous areas, and for the scale of the projection the ratio of  $1^\circ$  of longitude on the chart to the actual longitudinal length of the earth at  $35^\circ$  of latitude is adopted.

The scale of a plan is indicated by fractions of the actual length.

The foregoing observations generally apply to the charts prepared by the Department for foreign regions.

The following table gives the numbers of the new and revised editions, etc. of charts in the recent years:

Year.	New editions.	Revised editions.	Second editions.	Editions cancelled.
1917	50	38	8	108
1918	67	65	23	61
1919	130	58	27	100
1920	56	51	31	85
1921	135	59	25	128
1922	122	49	25	14
1923	42	8	1,024	7
1924	79	34	242	38
1925	193	147	117	157

## SAILING DIRECTIONS, NOTICES TO MARINERS, LIGHT LIST.

It may be authoritatively stated that the first hydrographic description of Japan is the "Kasuga Kikō," written by Lieut. Yanagi in 1871, and containing information obtained in his "Hokkai" surveying voyage as captain of the warship "Kasuga." The first hydrographic information from a ship was received in this Department in 1874, when an officer of the "Nissin" forwarded some valuable details about certain anchorages in the southern part of Taiwan (Formosa). By collating the data subsequently obtained, this Department published, in the period 1873-1875, several sailing directions such as South Islands Pilot, Taiwan Pilot, and Hokkaidō Pilot, though these were extremely limited in contents, and similar publications by the British and United States hydrographers supplied most important information about those quarters.

In 1876, the "Suiro Zassi" (hydrographic magazine) Nos. 1 and 2 were issued, the former containing the hydrographic accounts of Korea obtained by an officer of the "Nissin", and the latter of the Tisima Islands by the same officer. These publications may be called the precursors of the "Suiro Hôdô" (hydrographic information).

In 1877, the "Suiro-teiyō", containing explanations of hydrographic terms and signs and abbreviations appearing on foreign charts, was published.



In 1879, this Department decided that Notices to Mariners should thereafter be issued immediately on receipt of any valuable hydrographic information, instead of as formerly, occasionally, and, subject to much delay, through the medium of the "Suiro Zassi" etc., and that these Notices should be not only forwarded directly to Naval ships but also published in two daily newspapers. The publication of Notices to Mariners in newspapers was continued until the medium of the Official Gazette was utilized for the purpose.

At present Notice to Mariners are published weekly and also, as a general rule, inserted in the Official Gazette of every Saturday.

All Notices of an urgent character have been broadcasted since February, 1926, from the Tōkyō W/T Bureau, and continue to be so broadcasted.

The translation of foreign sailing directions was commenced from 1880. In the following year, a volume of such translations covering parts of the Chinese coast was issued, and by 1886 twelve volumes, including two for the whole coast of Japan, had been issued. Since, however, our warships generally carry no charts for foreign coasts except those for our neighbouring waters, the sailing directions issued in 1889 and hence were confined within the limits of these latter.

In 1890, a supplement to the Japan Pilot was issued, being the first of such supplements.

In 1897, the sailing directions for Japan, Tyōsen (Korea), and Russian Maritime Province, and in the following

year the China Pilot were completed.

These sailing directions together with those for Bengal, Philippine, Borneo, the western and eastern sides of China Sea, the most parts of Eastern Archipelago, and Hawaii are published in 30 volumes. It is projected to publish the sailing directions for the whole Pacific Ocean and the Indian Ocean in future.

The light list for this country was at first issued from the Light House Division of the Engineering Department (now defunct) and this Department published in 1874 a list of light houses and light ships for the Chinese coast. Since 1883, the light list for the Orient has been issued from this Department.

This Department began publishing "Suiro-Yôhō (Hydrographic Bulletin) monthly from the first of September, 1922. It contains supplementary notices to mariners, important information on routes, and other matters for reference by mariners and the results of research works.

## PRINTING.

### 1. Copper Plate Printing.

Formerly only the Dutch copper etching process was in use at this Department for the preparation of charts, and copper plate engraving was adopted for the first time in 1907. These two processes were used conjointly until 1915, when the development and extensive use of the photo-etching process relegated the former processes to special charts and retouching work only. In this latter process, before etching, a print was made on the sensitized surface of a copper-plate by exposing it to the sun together with a positive plate obtained photographically from an original chart. Since 1918, a more advanced process has been used in which the print on theosensitized surface of copper can be obtained, without using any positives, by exposing it to the sun together with the original semitransparent paper chart.

Electro-type printing and copper-plate printing by transfer from lithographic stone are also used on a small scale; and, for cutting such figures as compasses and scales on border lines, or for the shading of land, requisite instruments are employed.

### 2. Lithographic and Zinc-plate Printings.

In this Department, lithography was used for chart making for years, from 1879 to 1915, and was regarded as necessary for quick work, although not able to supercede

copper-plate printing which had its advantages in the clearness of the impression. Except for a short period in its early days when the actual drawing process was employed, the method in use at this Department was that of transferring.

On the other hand, zinc-plate printing was studied by this Department from 1894, and aluminium-plate printing from 1905, and while the latter method proved to be of no practical use, this Department made so great a progress in the former that in 1914 it entirely discarded stone in favour of zinc. A still more remarkable development took place after that time. In 1915 it became possible for the Department to produce the figure of a chart on zinc-plate from the negative plate obtained photographically from a fair copied original chart, and since 1919 the work has been produced on zinc-plates directly from the fair copied semi-transparent original chart. The latter process of producing positive figures directly from positive works ensures perfect clearness of charts and is at present used by the Department in preference to the other processes.

3. Both copper-plate and zinc-plate are now prepared in this Department, that is, charts are first produced by zinc-plate, and afterwards engraving on copper is, if necessary, commenced. To be more exact, this Department preserves zinc-plate as the fundamental, and does not prepare copper-plate unless it is either for very complicated topography or for highly detailed surveys.

As to presses, copper-plate printing presses were used from the early days of this Department, while lithographic

presses were introduced later on. At present, this Department obtains prints generally by zinc-plate printing or zinc-plate printing by transfer from engraved copper.

As chart paper requires moderate tenacity and the least possible liability to contraction and distortion, and offset printing is therefore preferable to direct printing, this Department has used such paper since 1924.

4. The numbers of copies printed during the recent years are given in the following table :

Year.		1917	1918	1919	1920	1921	1922	1923	1924	1925
Charts.		286,783	571,395	289,815	199,176	175,469	116,801	59,072	179,566	206,813
Miscellaneous Charts.		51,054	104,856	106,822	200,209	236,735	76,646	58,761	256,975	459,667
Books.	Copies	27,005	16,560	21,728	53,205	17,356				
	pages	2,410,720	2,871,330	5,243,356	7,111,280	4,067,755	27,805	19,720	25,554	50,010
Notices to Mariners.	Copies	153	127	94	102	104	78	59	66	680
	pages	648,880	663,960	578,080	717,930	931,610	1,040,400	172,700	168,550	172,550

## EXPENDITURE (ESTIMATED) AND PERSONNEL.

The following table shows the estimated expenditure of this Department since its foundation.

1871	Unknown.	1900	¥ 204,166
1872	¥ 21,060	1901	233,635
1873	Unknown.	1902	259,988
1874	35,319	1903	258,336
1875	34,071	1904	234,908
1876	37,846	1905	457,594
1877	42,111	1906	326,557
1878	60,160	1907	389,939
1879	45,780	1908	342,369
1880	54,031	1909	338,736
1881	51,342	1910	350,548
1882	51,511	1911	405,272
1883	65,845	1912	332,301
1884	68,335	1913	252,057
1885	57,647	1914	354,658
1886	96,746.606	1915	251,065
1887	86,503.183	1916	328,173
1888	89,155.362	1917	334,314
1889	71,381.536	1918	538,891
1890	78,300	1919	609,885
1891	74,225	1920	856,642
1892	70,208	1921	859,336
1893	Unknown.	1922	1,056,808
1894	"	1923	1,078,542
1895	"	1924	1,009,384
1896	"	1925	1,018,045
1897	126,617		
1898	166,827		
1899	210,523		

The following table shows the number of the personnel of this Department on the 31st March of each year from 1912 onwards :

Year.	Naval officers.	Civil Officials. (Sōnin rank)	Civil Officials. (Hannin rank)	Employees.	Extra Employees.	Total.
1912	22	5	38	162	39	266
1913	22	7	38	145	37	249
1914	22	4	38	147	57	268
1915	21	4	38	159	64	286
1916	23	6	40	189	68	326
1917	23	7	39	224	47	340
1918	23	9	38	253	51	374
1919	21	12	53	276	35	397
1920	26	14	55	266	44	405
1921	27	16	57	290	38	428
1922	27	10	51	238	96	422
1923	23	10	58	224	96	411
1924	28	9 Chokunin 1	58	249	99	444
1925	27	"	64	325	146	572

## MISCELLANEOUS.

1. The publications of this Department registered on its list on the 1st April, 1925, numbered as follows :

Charts .....	1,486
Miscellaneous charts .....	102
Books .....	68
Miscellaneous drawings .....	7

2. The copies of hydrographic publications forwarded to, or received from, foreign Hydrographic Offices numbered as follows : .

Year.	Forwarded.			Received.		
	Charts.	Notices to Mariners.	Books.	Charts.	Notices to Mariners.	Books.
1917	426	37,216	16	250	5,246	164
1918	449	25,010	39	339	4,861	149
1919	887	13,640	13	350	5,983	149
1920	885	9,435	69	491	5,279	235
1921	1,003	20,375	122	1,523	5,654	289
1922	1,595	11,142	238	418	5,780	306
1923	0	8,865	283	5,844	5,480	434
1924	1,476	10,049	1,065	7,333	6,939	518
1925	1,950	10,514	848	1,727	9,100	371

3. The number of copies of this Department's charts and books sold and the total prices are as follows :



Year.	Charts.		Books.	
	Copies.	Price (Yen).	Copies.	Price (Yen).
1917	108,032	76,443.25	10,559	12,005.85
1918	378,494	316,077.75	14,419	17,873.55
1919	121,205	119,383.35	12,116	19,792.40
1920	113,992	125,138.60	15,930	34,778.00
1921	48,036	58,212.05	8,090	14,667.50
1922	61,301	76,958.10	7,560	10,196.50
1923	87,745	114,181.70	12,395	12,148.50
1924	109,628	128,354.40	15,030	21,226.00
1925	96,352	132,844.80	14,670	20,798.50

4. The agents for the sale of this Department's publications are as follows (copies of Notices to Mariners, and forms for hydrographical and navigational information may be obtained gratis on application to these agents):

Tôkyô: Nippon Yusen Kaisha, No. 1, Ittyôme, Yûrakutyô, Kôzimatiku.

Kôbe: Kôbe branch of Nippon Yusen Kaisha No. 10, Ittyôme, Kaigan-dôri.  
Nippon Senshu Kyôkai, No. 32, Akasi-tyô.

Ôsaka: Ôsaka branch of Nippon Yusen Kaisha, No. 26, Kâwagutityô, Nisi-ku.

Nagasaki: Nagasaki branch of Nippon Yusen Kaisha, No. 3, Megasaki-tyô.

Hakodate: Hakodate branch of Nippon Yusen Kaisha, No. 19, Hunaba-tyô.

Mozi: Mozi branch of Nippon Yusen Kaisha, No 6, Hama-tyô.

Husan: Husan agent of Nippon Yusen Kaisha, (Genzi Ôike), No. 7, Umetate-sinmati.

Shanghai: Shanghai branch of Nippon Yusen Kaisha, No. 3, North Yangtze Road.

The following agents sell thin paper charts only:

Tôkyô: M. Kobayasi, No. 4, Hayabusa-tyô, Kôzima-ti-ku.

5. Notices to Mariners are also kept in the following government offices for mariners' consultation without charge:

a. Prefectural offices on Tyôsen coast at:—

Tinnanpo (Teidon), Zinsen (Chemulpho)

Mokuho, Husan (Pusan)

Won san tin, Tyonzin.

d. Japanese Consulates at:—

Bombay, Han-kow, Singapore,

Hang-choo, Fu-chow, Chifu,

Tientsin, Niu-chuang, Vladivostok,

Manila, Hongkong, Bangkok,

Amoy, Swatou, Shanghai,

Vancouver, Seattle, San Francisco,

Sydney, Honolulu.

6. Office of this Department:

No. 1, Yontyôme, Tukizi, Kyôbasi-ku, Tôkyô.